

# Improvements in hip arthroplasty - did they work?

## Evaluation of different articulations and fixation concepts

### AKADEMISK AVHANDLING

som för avläggande av medicine doktorsexamen vid Sahlgrenska Akademin, Göteborgs universitet kommer att offentligens försvaras i R-husets Aula, Göteborgsvägen 31, Sahlgrenska Universitetssjukhuset Mölndal

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av

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Avhandlingen baseras på följande delarbeten:

- I. Johanson PE, Fenstad AM, Furnes O, Garellick G, Havelin LI, Overgaard S, Pedersen AB, Kärrholm J. **Inferior outcome after hip resurfacing arthroplasty than after conventional arthroplasty. Evidence from the Nordic Arthroplasty Register Association (NARA) database, 1995 to 2007.** Acta Orthop. 2010 Oct;81(5):535-41. doi: 10.3109/17453674.2010.525193.
- II. Johanson PE, Digas G, Herberts P, Thanner J, Kärrholm J. **Highly crosslinked polyethylene does not reduce aseptic loosening in cemented THA. 10-year findings of a randomized study.** Clin Orthop Relat Res. 2012 Nov;470(11):3083-93. doi: 10.1007/s11999-012-2400-x.
- III. Johanson PE, Furnes O, Ivar Havelin L, Fenstad AM, Pedersen AB, Overgaard S, Garellick G, Mäkelä K, Kärrholm J. **Outcome in design-specific comparisons between highly crosslinked and conventional polyethylene in total hip arthroplasty.** Acta Orthop. 2017 Aug;88(4):363-69. doi: 10.1080/17453674.2017.1307676.
- IV. Johanson PE, Antonsson M, Shareghi B, Kärrholm J. **Early subsidence predicts failure of a cemented femoral stem with minor design changes.** Clin Orthop Relat Res. 2016 Oct;474(10):2221-9. doi: 10.1007/s11999-016-4884-2.
- V. Johanson PE, Shareghi B, Eriksson M, Kärrholm J. **Wear measurements with use of radiostereometric analysis in total hip arthroplasty with obscured femoral head.** In manuscript.
- VI. Johanson PE, Shareghi B, Eriksson M, Kärrholm J. **Ceramic-on-ceramic versus metal-on-polyethylene articulation in uncemented hip arthroplasty. A prospective randomized study with 7 years follow up.** In manuscript.

## ABSTRACT

Today, total hip arthroplasty (THA) is one of the safest and most efficient surgical treatments. New materials, surgical techniques and design concepts intended to improve THA have not always been successful. Thorough preclinical and early clinical investigations can detect some aspects of under-performing, while continuing surveillance is recommended to detect and analyze reasons for any later appearing flaws. In this thesis, several ways to monitor and assess THA performance are explored and carried out, using survival analysis in registry studies, radiostereometry (RSA), radiology and clinical outcome.

In Paper I, a study using the Nordic Arthroplasty Register Association (NARA) registry shows that HRA had an almost 3-fold increased early non-septic revision risk and that risk factors were found to be female sex, certain HRA designs and units having performed few HRA procedures. Papers II and III contain comparisons of highly cross-linked polyethylene (XLPE) and conventional polyethylene (PE). XLPE had a considerably lower wear rate up to 10 years but showed no obvious improvements regarding implant fixation, BMD or clinical outcome. In the NARA registry, in 2 of 4 studied cup designs the XLPE version had a lower risk of revision for aseptic loosening compared to the PE version. Paper IV describes that stem subsidence and retrotorsion measured with RSA at 2 years predicted later aseptic stem failure in an unfavorably altered, previously well-functioning cemented femoral stem. In Paper V and VI, a novel approach to measure articulation wear with RSA in radiodense hip arthroplasty articulations was presented and evaluated. Subsequently, a comparison between ceramic-on-ceramic (COC) and metal-on-conventional PE uncemented THA displayed a considerably lower wear rate, smaller periacetabular bone lesions and a relatively high squeaking rate, the latter with unknown long-term consequences, in the COC hips. Implant fixation, heterotopic ossification and clinical outcome did not differ between articulation types.

In conclusion, it was confirmed that implant surveillance can be done with RSA, also in radiodense THA. Early migration predicts later aseptic implant failure. Prolonged surveillance can confirm long-term material and design performance, verify or contradict anticipated advantages as well as detect unanticipated long-term complications.

**Keywords:** Hip arthroplasty, innovation, outcome

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